

Appendix B
Recommended Recovery Category
Modifications Based on the 2019
Bathymetry Survey

1 Introduction

Recovery category areas are an important component of the remedial actions identified in the Lower Duwamish Waterway (LDW) Record of Decision (ROD) (EPA 2014) and are used to help identify the spatial application of remedial action levels (RALs) and remedial technologies. Recovery category areas were developed in the feasibility study (FS) (AECOM 2012) based on the criteria presented in ROD Table 23. As defined in the ROD, Recovery Category 1 refers to recovery that is presumed to be limited, Recovery Category 2 refers to recovery that is uncertain, and Recovery Category 3 refers to recovery that is predicted to occur with some confidence. The recovery category areas depicted in ROD Figure 17 were revised in the *Recovery Category Recommendations Report* (Integral et al. 2019) to serve as a starting point for this analysis (Figure B-1). Figure B-1 also shows the “analysis areas” that are referenced in this appendix to allow for area-specific recovery category discussion.¹

In general, recovery category areas are delineated based on the following physical and chemical criteria:

1. Identification of observed vessel-induced scour areas based on a visual review of a sun-illuminated bathymetric survey map produced from a comprehensive site-wide bathymetric survey. The 2003 bathymetric survey conducted for the remedial investigation (RI)/FS was used to delineate the recovery category areas defined in the ROD.
2. Identification of berthing areas based on waterway configuration (i.e., location of docks), review of the 2002 US Army Corps of Engineers Port Series report (USACE 2002), and review of the waterway user survey with its assessment of in-water structures (Integral et al. 2018).
3. Identification of sediment transport model (STM)-predicted 100-year high-flow event scour areas and STM-predicted net-scour areas as presented in the FS.
4. Empirical contaminant trends over time.

The modifications to the ROD recovery category areas that were made in the *Recovery Category Recommendations Report* (Integral et al. 2019) were based on criteria 2 and 4 above.² This appendix uses the recent 2019 bathymetric survey to develop a sun-illumination map to reassess observed vessel-induced scour areas (criterion 1). In this appendix, the 2019 bathymetric survey results are also compared with the 2003 bathymetric survey results to empirically identify net changes to waterway elevations that have developed over the past 16 years. This analysis provides supplemental lines of evidence that might identify scour that was not well captured in the sun-illumination map, and that should be considered in design.

¹ The recovery category boundaries are shown as jagged lines due to an artifact of the mapping methods used during the FS and ROD processes. Where recovery category areas have been modified, the lines are smooth.

² Empirical contaminant trends over time (criterion 4) were also evaluated but did not result in changes to the recovery category areas.

Additional modifications to the recovery category areas within the upper reach may be identified based on Pre-Design Investigation (PDI) chemistry data (criterion 4) in the forthcoming PDI Phase I and Phase II data evaluation reports.

2 Methods

Northwest Hydro, Inc. collected bathymetry data within the upper reach in April and May 2019, providing new data to reassess observed vessel-induced scour areas. Vessel-induced scour near and in berthing areas was evaluated by examining a sun-illumination bathymetry map (Figure B-2), consistent with the analysis performed for the FS (FS Section 2.3.1.1). Multi-beam bathymetric soundings were converted into a digital terrain model of the three-dimensional mudline elevations, and the digital terrain model was then used to generate a sun-illumination map.

The highlights and shading on the sun-illumination map emphasize fine-scale features and vertical relief to aid in the visual identification of bedform features that may be due to scour from vessel propeller wash (propwash), vessel grounding, or anchoring or spudding from vessel operations. The features can include ridges and furrows, depressions, and other disturbance features. However, it is important to assess the actual vertical elevation difference represented by the sun-illumination figure, because the angle of illumination can create shading for even very small elevation differences (e.g., inches) that imply greater bed disturbance than is actually present in the bed. Additionally, survey accuracy must be considered when evaluating bed disturbance.³ As a general guide, bed vertical disturbances of approximately 6 inches or less are not considered sufficient to indicate bed disturbance that precludes natural recovery.

To provide additional information on potential bed disturbances in the upper reach, the sun-illumination map was analyzed in conjunction with the following two supplemental lines of evidence related to the survey:

- A. Analysis of changes in bed elevations between the 2003 and 2019 bathymetric surveys that could be indicative of net scour or deposition (or caused by other factors such as dredging or construction impacts) over the 16-year period
- B. Consideration of waterway use based on the configuration of docks and infrastructure observed using maps and satellite imagery

In supplemental line of evidence A, empirical net-scour or deposition patterns were identified by changes in bathymetric elevation between the 2003 and 2019 bathymetric surveys depicted in an isopach map (Figure B-3). Changes in bathymetry may have multiple potential causes: ongoing

³ Changes in bathymetric elevation of +/- 4 inches are functionally considered no change in elevation, because the results are within the accuracy limits of the evaluation (vertical accuracy of individual RTK-GPS multibeam surveys in shallow water is in the range of +/- 0.3 foot [USACE 2013]).

natural sedimentation processes; dredging, excavation, structure removal or construction, or material placement that occurred between the two surveys; bed erosion due to surface water flows; vessel-induced scour from vessel propwash; or bed disturbance from other vessel operations (e.g., spudding, anchoring, grounding). For this analysis, the isopach map was used as a supplemental line of evidence to the sun-illumination maps. The evidence from the isopach map can help to identify areas of positive change (referred to as deposition), negative change (referred to as scour), or no net-elevation change, but this empirical information should not override the predicted STM results (criterion 3) because of the longer-term duration of the STM analysis (which analyzes the impact of a 100-year high-flow event).

Supplemental line of evidence B was used to aid in the interpretation of bedform features, including site waterway use and recent construction activities within the upper reach. This line of evidence considered the configuration of overwater structures, berthing areas, dredging and material placement areas, bridges, piles, and dolphins. For example, some docks show evidence of high-frequency vessel traffic, while some structures block access to maneuvering vessels. In addition, several construction projects have modified the bed features of the upper reach, including the following:

- Reconstruction (including moving foundations) of the South Park Bridge
- Dredging and material placement performed for three early action areas (EAAs) at Boeing Plant 2, Terminal 117, and Jorgensen Forge
- Navigation dredging of the outer Delta Marine Dock and the federal navigation channel (FNC) from river mile (RM) 4.26 to RM 4.7.

Modifications to the hydrodynamic system can result in changes in bathymetry until a new dynamic equilibrium is reached. While this may not be from vessel scour, it still needs to be considered to ensure appropriate designs are applied.

For all discrete locations within the upper reach, the two supplemental lines of evidence were considered together with criterion 1 using engineering professional judgment to recommend modifications to the recovery category areas identified in the ROD. As noted, this analysis evaluated potential bed disturbance from vessel activities, but it did not modify the Recovery Category 1 areas based on the STM predictions (i.e., 100-year high-flow event scour areas and net-scour areas). This is because the STM simulates longer time horizons, whereas this analysis represents a single point in time (sun-illumination map) or compares two points in time separated by 16 years (isopach map).

3 Recovery Category Modifications

Table B-1 summarizes the evaluation for all analysis areas within the upper reach. Table B-1 identifies each analysis area by river mile and side of the LDW (east [E], FNC, and west [W]), lists the current

recovery category designation, summarizes criterion 1 and the two supplemental lines of evidence, and proposes any recovery category area changes. Table B-1 covers all areas of the upper reach, excluding the EAAs, which do not have recovery category designations. As shown in Figures B-4 to B-9, six areas were identified for recovery category area modification or refinement based on this evaluation; these six areas are discussed in the rest of this section.

3.1 Analysis Area 2, RM 3.23 to RM 3.37: South Park Bridge

Area 2 stretches from the west bank of the LDW to the edge of the Boeing Plant 2 EAA. It includes Recovery Category 1 in the FNC (based on STM high-flow scour) and Recovery Category 3 on the west bank (Figure B-1). The South Park Bridge was reconstructed from 2011 to 2014, and the sun-illumination map (criterion 1, Figure B-2) shows significant⁴ bed disturbance within the area due to construction activities during bridge replacement and the modification of river flow paths around structures. Similarly, the isopach map (supplemental line of evidence A; Figure B-3) shows areas that have deeper bed elevations in 2019 than they did in 2003, likely due to bridge replacement construction activities around the current and former alignment (supplemental line of evidence B) that modified river flow paths around structures. Downstream bank disturbances (RM 3.25 to RM 3.28) could be due to construction activities, changes in hydrodynamic current flows, or vessel-induced scour. Although it is unclear whether disturbance in the area is ongoing, it is recommended that the downstream bed disturbance areas be changed to Recovery Category 1. The recovery category for the bed disturbance area adjacent to the reconstructed bridge piers remains unchanged, because the disturbance in that area appears to be due primarily to reconstruction activities, which are complete (Figure B-4).

3.2 Analysis Area 6, RM 3.9 to RM 4.03 W: McElroy Dock

McElroy Dock berthing area had been identified as Recovery Category 1 in the FS (Figure B-1). The 2019 sun-illumination map (criterion 1; Figure B-2) and isopach map (supplemental line of evidence A; Figure B-3) show evidence of continued bed disturbance; however, the delineation of the Recovery Category 1 area is recommended to be modified (Figure B-5) to capture the limits of apparent bed disturbances. To the north, the FS Recovery Category 1 boundary did not capture the extent of disturbed bed, and the Recovery Category 1 area is recommended to be expanded northward (criterion 1 and supplemental line of evidence A). To the south, the boundary is recommended to be truncated to align with the Duwamish Yacht Club Marina, which does not have evidence of vessel-induced scour (criterion 1) and shows high deposition (i.e., positive net-elevation change; supplemental line of evidence A). To the west, the boundary is recommended to be refined

⁴ The term "significant" is used in this analysis to denote areas where natural recovery is presumed to be limited (consistent with the definition of Recovery Category 1) due to ongoing mixing from vessel scour or other vessel-induced bed disturbance (e.g., anchoring) deeper than the surface sediment layer.

to align with the dock, which represents the extent of active berthing (supplemental line of evidence B; Figure B-5).

3.3 Analysis Area 10, RM 4.03 to RM 4.26E: Slip 6

This area includes Slip 6 and the areas directly to the north and the south of the slip (Figure B-1). This area was designated in the FS as a mixture of Recovery Categories 1, 2, and 3, depending on the location. The bathymetric evidence is consistent with these recovery categories; however, the delineation of the Recovery Category 1 area is recommended to be modified so that stable intertidal mudflats are not included in Recovery Category 1.

North of Slip 6 are several mooring dolphins, the Northwest Container Services berthing area, and an intertidal mudflat. The mudflat behind the Northwest Container Services dolphins was identified as Recovery Category 1 but does not show evidence of bed disturbance (criterion 1), and the mooring structures restrict access by vessels in this area (supplemental line of evidence B). Therefore, the intertidal mudflat area is recommended to be modified to Recovery Category 3 (Figure B-6).

South of the mouth of Slip 6, the Recovery Category 1 area in the intertidal mudflat along the shoreline is recommended to be changed to Recovery Category 3, because there is no evidence of vessel scour (criterion 1) and the area is too shallow for navigation (supplemental line of evidence B; Figure B-6). However, Recovery Category 1 is maintained along the FNC, where bed disturbance is evident in the sun-illumination map and the isopach map (criterion 1 and line of evidence A).

3.4 Analysis Area 11, RM 4.17 to RM 4.26W: Delta Marine

This area includes the Delta Marine T-dock and haul-out facility, which were designated as Recovery Category 1 in the FS (Figure B-1). The bathymetric evidence is consistent with the FS recovery category designation in the area but with a modified boundary to capture bed disturbance noted on the sun-illumination map (criterion 1) and areas accessible to vessels (supplemental line of evidence B). The southern boundary is recommended to be modified to capture the haul-out and the area of bed disturbance at the mouth of the haul-out. The northern boundary is recommended to be reduced to align with the extent of the berthing area and the limit of bed disturbance (criterion 1 and supplemental line of evidence B; Figure B-7).

3.5 Analysis Area 12, RM 4.4 to RM 4.5W: North Turning Basin

RM 4.4 to RM 4.5W includes strips of Recovery Category 1 due to STM modeling results plus Recovery Category 3 in the rest of the area (Figure B-1). The bedform features on the sun-illumination map (criterion 1; Figure B-2) and isopach map (supplemental line of evidence A; Figure B-3) show river flow scour immediately adjacent to the STM model-based Recovery Category 1 area. Therefore, the Recovery Category 1 area is recommended to be extended to the

west and slightly south to capture the observed extent of net scour in the isopach map (supplemental line of evidence A) that is immediately adjacent to the STM model predicted net-scour area (Figure B-8).

3.6 Analysis Area 14, RM 4.76 to RM 5.0: Upstream of Turning Basin

The area south of the turning basin was not designated for a recovery category in the FS, because the STM did not provide scour predictions in the area, and most of the area was not surveyed in 2003 (Figure B-1). Based on the 2019 survey, the bedform contours are consistent with relatively high-velocity river flows (criterion 1), but downstream and upstream bridges preclude vessels (other than small boats) from entering most of this area. Considered together, Recovery Category 2 is recommended for the area (Figure B-9).

3.7 Summary and Next Steps

In summary, criterion 1 and the supplemental lines of evidence have been reviewed and engineering judgment has been applied to recommend several modifications to the recovery category areas, as summarized in Figure B-10. Table B-2 summarizes the acreage changes to the recovery category areas.

These recovery category designations will be used in remedial design to apply the appropriate RALs and evaluate remedial technologies for areas of the site.

As noted in the introduction, additional modifications to the recovery category areas within the upper reach may be identified based on PDI chemistry data (criterion 4) in the forthcoming PDI Phase I and II data evaluation reports.

4 References

- AECOM, 2012. *Final Feasibility Study, Lower Duwamish Waterway (Seattle, Washington)*. Submitted to U.S. Environmental Protection Agency (Region 10) and Washington State Department of Ecology (Northwest Regional Office). October 31, 2012.
- Anchor QEA and Windward (Anchor QEA, LLC, and Windward Environmental, LLC), 2019. *Remedial Design Work Plan for the Lower Duwamish Waterway Upper Reach*. Submitted to U.S. Environmental Protection Agency, Region 10.
- EPA (U.S. Environmental Protection Agency), 2014. *Record of Decision, Lower Duwamish Waterway*. Seattle, Washington. EPA ID: WA00002329803. U.S. Environmental Protection Agency Region 10, Seattle, Washington. November 2014.

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USACE, 2013. *Engineering and Design: Hydrographic Surveying*. EM 1110-2-1003. Department of the Army, U.S. Army Corps of Engineers. November 2013.

Table B-1
Upper Reach Recovery Category Evaluation Summary

Analysis Area #	River Mile	Location	River Side	Current Recovery Category Designation	Recovery Category Criterion 1	Supplemental Lines of Evidence		Conclusion and Rationale
					Vessel-Induced Scour (Analysis of Bed Sediment Disturbance Using the Sun-Illumination Map) ^a	A) Analysis of Changes in Bathymetry from 2003 to 2019 Using the Isopach Map (Supplemental Line of Evidence)	B) Waterway Usage (Supplemental Line of Evidence)	
1	3.0 to 3.23	Duwamish Waterway Park and adjacent FNC and south to the South Park Bridge Area	W	RC3 (W shoreline)	No vessel-induced scour features.	Mixture of measurable deposition areas or no detectable changes.	No water-dependent industry or infrastructure in the location.	No changes to RCs.
			FNC	RC1 (deeper water/FNC)	No significant vessel-induced scour features.	Mixture of measurable deposition areas or no detectable changes.	FNC transiting.	No change. RC1 area (based on STM high-flow scour prediction) is not modified.
2	3.23 to 3.37	South Park Bridge and Cable Area west bank and FNC. See Figure B-4	W	RC3 (W shoreline)	Bed disturbances showing as depressions and mounds along the shallow subtidal west bank from the South Park Marina boat launch northward under the South Park Bridge and to the north approximately 500 feet from the bridge. Possibly due to bridge reconstruction activities and change in river flows around the new bridge structure.	Mixture of areas with measurable deposition and several depressions of apparent net scour downstream of the bridge. The apparent net scour may be ongoing or may represent the new stable condition of the bed. Around the South Park Bridge footprint, changes in bathymetry are observed that are likely due to bridge modifications.	Construction/demolition of bridge structure. Residential boat launch at RM 3.24W and South Park Marina boat launch at RM 3.36W support recreational vessels and are not expected to significantly disturb the bed.	Convert RC3 to RC1 in two areas to capture bed disturbance (criterion 1) and depressions of apparent net scour downstream of the South Park Bridge (supplemental line of evidence A).
			FNC	RC1 and RC3 (FNC)	No significant vessel-induced scour features.	Mixture of areas with measurable deposition and depressions of apparent net scour downstream under the bridge.	Construction/demolition of bridge structure.	Convert RC3 to RC1 in one area to capture the depression of apparent net scour immediately under the South Park Bridge (supplemental line of evidence A).
3	3.37 to 3.5	South Park Marina and adjacent FNC	W	RC3 (marina)	No significant vessel-induced scour features. Evidence of boat slips and the presence of piling in the survey.	No data (not surveyed in 2003).	Marina activities.	No change.
			FNC	RC1 and RC3 (FNC)	No significant vessel-induced scour features.	Measurable deposition areas, especially on the west side of the FNC.	FNC transiting.	No change. The sliver of RC1 in the east side of the FNC (based on STM high-flow scour prediction) is not modified.
4	3.5 to 3.7	Area between Terminal 117 EAA (W bank) and Boeing Plant 2 / Jorgensen Forge EAAs (E bank)	FNC	Primarily RC1 (FNC) with some of RC3 (western fringes)	No significant vessel-induced scour features.	West side of FNC: Measurable deposition areas. East side of FNC: Deeper bathymetry due to EAA construction.	FNC transiting.	No change. RC1 area (most of the area; based on STM high-flow scour prediction) is not modified.
5	3.7 to 3.9	Straight navigation channel with gradual intertidal slopes on both sides. Activated carbon pilot intertidal plot (RM 3.85E)	W	RC3 (W)	No significant vessel-induced scour features.	Mixture of measurable deposition areas and no change.	No water-dependent industry.	No change.
			FNC	RC1 (FNC)	No significant vessel-induced scour features.	Measurable deposition areas, especially on the west side.	FNC transiting.	No change. RC1 based on STM high-flow scour prediction is not modified.
			E	RC2 (E)	No significant vessel-induced scour features.	No change with isolated areas of net scour along the slope to the FNC. Pilot plot shows increased elevation due to material placement.	No water-dependent industry.	No change.

Analysis Area #	River Mile	Location	River Side	Current Recovery Category Designation	Recovery Category Criterion 1	Supplemental Lines of Evidence		Conclusion and Rationale
					Vessel-Induced Scour (Analysis of Bed Sediment Disturbance Using the Sun-Illumination Map) ^a	A) Analysis of Changes in Bathymetry from 2003 to 2019 Using the Isopach Map (Supplemental Line of Evidence)	B) Waterway Usage (Supplemental Line of Evidence)	
6	3.9 to 4.03	McElroy dock (W bank). See Figure B-5	W	RC1	Bed disturbance evident.	Mixed areas of net scour and deposition.	Active berthing area.	RC1 is modified to capture bed disturbance from the sun-illumination map (criterion 1) and net scour areas from the isopach map (supplemental line of evidence A). Northern boundary: RC1 area expanded to capture several net-scour depressions on the sun-illumination map (criterion 1) and isopach map (supplemental line of evidence A). Southern boundary: RC1 area modified to align with the Duwamish Yacht Club Marina, which is highly depositional (supplemental line of evidence A) and does not indicate significant vessel-induced scour (criterion 1). Western boundary: The boundary will be refined to align with the dock, which represents the extent of active berthing (criterion 1 and supplemental lines of evidence A and B). Eastern boundary: Boundary remains at the FNC.
7	3.9 to 4.03	FNC	FNC	RC1 and RC3	No evidence for vessel-induced scour.	Measurable deposition areas.	FNC transiting.	No change. RC1 based on STM-predicted high-flow scour is not modified.
8	3.9 to 4.03	Natural bank, activated carbon pilot intertidal plot (RM 3.9E)	E	RC2	No evidence for vessel-induced scour.	Mostly no change with some areas of deepening elevations in the intertidal. Pilot plot shows increased bed elevation.	No water-dependent industry.	No change. Bathymetric features (criterion 1) and waterway usage (supplemental line of evidence B) consistent with RC3; however, due to minimal change in the intertidal area (supplemental line of evidence A), RC2 is reasonable.
9	4.03 to 4.17	Duwamish Yacht Club and adjacent navigation channel	W	RC3	No evidence for vessel-induced scour. Generally flat marina bathymetry with piling showing on the survey with shallower bathymetry in the southern portion.	Duwamish Yacht Club: High rates of sediment deposition.	Marina activities.	No change.
			FNC	RC3	Bathymetric evidence for maintenance dredging (stair step at RM 4.4).	FNC: Mix of shallower and deeper bathymetry due to sediment deposition combined with navigation dredging.	FNC transiting. Bed disturbance from maintenance dredging.	No change.

Analysis Area #	River Mile	Location	River Side	Current Recovery Category Designation	Recovery Category Criterion 1	Supplemental Lines of Evidence		Conclusion and Rationale
					Vessel-Induced Scour (Analysis of Bed Sediment Disturbance Using the Sun-Illumination Map) ^a	A) Analysis of Changes in Bathymetry from 2003 to 2019 Using the Isopach Map (Supplemental Line of Evidence)	B) Waterway Usage (Supplemental Line of Evidence)	
10	4.03 to 4.26	Slip 6 and Surrounding Area. See Figure B-6	E (RC3 Area north of Slip 6)	RC3 area north of Slip 6	Evidence of minor bed disturbance within the berthing area. No evidence for bed disturbance in the intertidal area.	Northwest Container Services berthing area: Measurable deposition. Intertidal mudflat: No change.	Northwest Container Services berthing area: Barge mooring. Intertidal mudflat: No vessel access.	No change.
			E (RC1 Area just north of Slip 6)	RC1 area including mouth of Slip 6 and the slope to the north)	Southern dolphin area (slope from intertidal to Slip 6): Evidence of bed disturbance. Intertidal mudflat: No evidence for bed disturbance.	Southern dolphin area (slope from intertidal to Slip 6): Deeper bathymetry due to ongoing disturbance. Intertidal mudflat: No change.	Southern dolphin area (slope from intertidal to Slip 6): Barge mooring. Intertidal mudflat: No vessel access; too shallow for vessel activity.	Reduce the RC1 area to exclude the intertidal mudflat without vessel activity. Minimal change in bathymetry elevations is observed, and vessel-induced scour is not evident (criterion 1 and both supplemental lines of evidence).
			E (Slip 6)	RC1 (within Slip 6) RC2 (northern part of the berthing area within Slip 6) RC3 (fringe areas within Slip 6)	Head of Slip 6: Evidence for minor bed disturbance. Mouth of Slip 6: Some evidence for bed disturbance although deep vessel track lines evident in 2003 survey have filled in.	Head of Slip 6: Highly depositional. Mouth of Slip 6: Variably depositional.	Active vessel maneuvering.	No change. Criterion 1 and both supplemental lines of evidence show a high rate of deposition (supplemental line of evidence A), minor bed disturbance (criterion 1), and active site waterway use (supplemental line of evidence B).
			E (South of Slip 6)	RC1 south of Slip 6 mouth	South of mouth of Slip 6: Evidence for bed disturbance along the steep slopes transitioning to the FNC.	South of mouth of Slip 6: Deeper bathymetry elevations along the steep slopes transitioning to the FNC; measurable deposition areas due to deposition in the intertidal.	Active vessel maneuvering in the adjacent FNC; no vessel activity in the intertidal mudflat.	Modify the RC1 area to exclude the intertidal mudflat, where no evidence supports the RC1 designation. Maintain the RC1 area along the FNC where bed disturbance is evident in the sun-illumination map and the isopach (criterion 1 and line of evidence A).
11	4.17 to 4.30	Delta Marine T-dock and haul-out, FNC. See Figure B-7	W	RC1 (Delta Marine berthing area)	Outer face of the dock: Flat with vessel-induced scour track lines to the north and south of the berth. Inner T-dock north area: No data. Inner T-dock south area: Shallow with evidence of vessel maneuvering toward the FNC. Haul-out: Evidence of dredging and/or vessel maneuvering near the mouth and to the north and south of the mouth.	Deeper bathymetry elevations due to dredging in the berth area. Measurable deposition areas on the fringes of the dredging areas.	Active vessel maneuvering.	Criterion 1 and the supplemental lines of evidence are consistent with RC1 in the area. The Delta Marine RC1 area is modified to capture bed disturbance from the sun-illumination map (criterion 1) and areas that vessels can access (supplemental line of evidence B). Southern boundary: RC1 area modified to align with the southern extent of the haul-out and the area of bed disturbance at the mouth of the haul-out (criterion 1 and supplemental line of evidence B). Northern boundary: RC1 area reduced to align with the extent of the berthing area and the limit of bed disturbance (criterion 1 and supplemental line of evidence B).
			FNC	RC1 and RC3 (FNC)	FNC: Evidence for bed disturbance from dredging.	Deeper bathymetry elevations due to dredging in the berth and the FNC.	FNC: Bed disturbance from maintenance dredging.	RC1 area (based on STM-predicted high-flow scour) is not modified.

Analysis Area #	River Mile	Location	River Side	Current Recovery Category Designation	Recovery Category Criterion 1	Supplemental Lines of Evidence		Conclusion and Rationale
					Vessel-Induced Scour (Analysis of Bed Sediment Disturbance Using the Sun-Illumination Map) ^a	A) Analysis of Changes in Bathymetry from 2003 to 2019 Using the Isopach Map (Supplemental Line of Evidence)	B) Waterway Usage (Supplemental Line of Evidence)	
12	4.30 to 4.52	Hamm Creek south to the turning basin	W	RC3 (W)	RM 4.4 to RM 4.5W indicates a high-flow scour feature at the base of the bank.	RM 4.26 to RM 4.40W: Predominantly no change. RM 4.40 to RM 4.50W: Narrow strip of deeper bathymetry elevation at the base of the bank.	No water-dependent industry.	Expand RC1 area slightly to the west to capture an adjacent sliver of net-scour area (criterion 1 and supplemental line of evidence A).
			FNC	RC1 (strips within and west of the FNC) RC3 (rest of the area)	FNC: Bed disturbance from maintenance dredging.	FNC: Deeper bathymetry elevations due to maintenance dredging.	FNC: Sediment disturbance from maintenance dredging.	No change.
			E	RC3 (E)	No evidence for vessel-induced scour.	RM 4.26 to RM 4.40E: Measurable deposition areas in the mudflat and net scour due to bed disturbance along the slope to the FNC. RM 4.40 to RM 4.50E: No net elevation change in the shallow elevations with deeper bathymetry elevation on the steep slope to the FNC that is likely the result of dredging activities.	No water-dependent industry.	No change.
13	4.52 to 4.8	Turning basin. See Figure B-8	W, FNC, E	RC1 (strips near either bank near the turning basin) RC3 (rest of the area)	Mudflats, river flow deposition, and erosional features, evidence of maintenance dredging.	Mixture of shallower and deeper bathymetry elevations due to deposition, high-flow net scour, and FNC dredging.	Turning basin.	No change. The turning basin is a dynamic net-depositional environment with frequent maintenance dredging (criterion 1 and both supplemental lines of evidence).
14	4.8 to 5.0	Upstream of Oxbow Footbridge. See Figure B-9	W and E	Not assigned	Evidence of river flow features.	No data (not surveyed in 2003).	Not accessible to vessels.	RC2 based on lack of vessel access (supplemental line of evidence B) and no observable bed disturbance (criterion 1).

Note
The term “significant” is used in this analysis to denote areas where natural recovery is presumed to be limited (consistent with the definition of Recovery Category 1) due to ongoing mixing from vessel scour.

Table B-2
Recovery Category Areas in the Upper Reach

Recovery Category Areas	Acreages from ROD Figure 17	Acreages After Recommended Modifications
1	33.2	31.2
2	4.9	20.2
3	66.4	60.8
Not designated	9.6	0
EAA ¹	17.3	19.3

Note:

1. EAA boundaries have been modified from the ROD to account for the final as-built areas for the T-117 and Boeing Plant 2 early action areas.

Appendix B Figures
